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# CENTRALIZED AND DISTRIBUTED ERP DEVELOPMENT MODELS: OPERATIONS AND CHALLENGES

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# CENTRALIZED AND DISTRIBUTED ERP DEVELOPMENT MODELS: OPERATIONS AND CHALLENGES

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## Abstract

*Different approaches to enterprise resource planning systems development are often mentioned in the IS literature. However, they are not usually explained thoroughly. The aims of this interpretive case study are thus to introduce two different approaches for developing tailored ERP systems and to explain how they function, i.e., how the information about different kinds of requests flows through the network of actors, from business needs to production. In addition, the challenges in development caused by these development approaches are considered. As a result, we have identified two different models for ERP development: centralized and distributed decision making. The most significant challenges are related to communication channels, transfer of domain knowledge, and the role of key individuals in the development activities. Both approaches are considered successful overall, yet distinctive strengths and defects can be identified from each.*

*Keywords: ERP, development, networks, communication, interpretive case study.*

# 1 INTRODUCTION

Enterprise Resource Planning (ERP) systems are almost the de facto standard of doing business in the modern environment. They promise organizations an all-in-one solution to seamlessly integrate information flow across the organization and thereby increase competitiveness (Davenport, 1998; Momoh et al., 2010). This has encouraged researchers and practitioners to focus on ERP (Dezdar & Sulaiman, 2009). Research often sees ERP development as a linear process, having certain starting and ending points and clear separate phases. This is not, however, the case in practice. ERP projects often start with matching the properties of the system to business processes (Damsgaard & Karlsbjerg, 2010; Davenport, 1998). Consequently, it can be argued that IS development is an ongoing activity (e.g., Alter, 2002) resembling a more constant evolution of the information system's landscape than an individual project. Nevertheless, systems and processes need to be adapted and aligned (Huq et al., 2006; Robey et al., 2002). Yet this adaptation process is prone to failures (Nandhakumar et al., 2005), so specialized expertise from outside the adopting organization (AO)<sup>1</sup> is utilized to overcome the challenges.

This indicates that ERP development constitutes a number of specialists and stakeholders from different organizations interacting and influencing each other (Levina, 2005; Damsgaard & Karlsbjerg, 2010; Doolin & McLeod, 2012). The stakeholders have been identified in the literature – but mostly on a very high level (Koch, 2007). For example, the vendor's perspective in ERP projects is less studied (Liang & Xue, 2004). Information systems (IS) research is lacking the understanding of these networks of actors and their actions in the ERP development (Pekkola et al., 2013).

ERP projects are prone to failures, such as cost overruns and even project cancellations (Pekkola et al., 2013). In fact, it has been estimated that over 90 percent of ERP implementations are unsuccessful to some degree (Momoh et al., 2010). The contemporary practice of conducting ERP development in multiple stakeholder networks further stresses the importance of communication – which can, however, be easily disturbed (Sarker & Lee, 2003). Yet these communication mechanism, patterns, and their root causes for failure are rarely studied (e.g., Dittrich et al., 2009; Pawlowski & Robey, 2004; Sathish et al., 2004).

This motivates our study: we want to first identify different ERP development networks (EDN), their actors, and their relationships, and second, we want to understand how these networks operate (i.e., what is the development model) and what their challenges are. Our research questions are thus (1) *what constitutes an ERP development network and how does it function*, and (2) *what challenges does each development approach introduce*. We answer these questions by providing a qualitative analysis of two significantly different ERP development situations: one with very centralized decision making on the adopting organization and its business side, and the other with very distributed decision making and operations across the EDN. The study will enrich our understanding of their potential features and functions as well as challenges related to development models.

This study begins by briefly describing the related research. This is followed by a summary of the research methods. Third, the case EDNs and their distinguishable features are presented. In the discussion, the findings are linked to the literature and different implications are discussed. Finally, the paper is wrapped up with conclusions along with a consideration of the limitations and directions for future research.

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<sup>1</sup> We want to stress the partnership between the vendor and the organization adopting the system, and thus, will not call the organization acquiring and using the system as simply a customer or client.

## 2 RELATED LITERATURE

ERP is both strategic choice and enterprise-wide system usually dealing with multiple stakeholders. By the term stakeholder we comprehend any individual, group, or organization that can affect or is affected by the ERP, i.e., all actors who can influence the ERP development are regarded as stakeholders. To initially define the EDN, we will draw on literature describing the networks and actors there. Related constructs have been called ERP community (Koch, 2007; Sammon & Adam, 2002), ERP ecosystem (Dittrich et al., 2009), and ERP vendor-partner alliance (Sarker et al., 2012).

EDNs are nearly always global, including many organizations and levels starting from the flagship organization, its partners, and all the way to end users of the AO (Doolin & McLeod, 2012; Ernst & Kim, 2002). It is often assumed that the most important stakeholders are the AO, the ERP vendor, and the ERP consultant (Sammon & Adam, 2002; Soh et al., 2000; Dittrich et al., 2009). Dittrich et al. (2009) go into a more detailed explanation about the development process by dividing the organizations further, suggesting that different personnel with specialized knowledge are needed between different stakeholders. For example, the vendor organization has both framework and application developers. Framework developers focus on the ERP system and its internal issues, and the application developers focus on the customer interface and consultancy. Especially in long-term cooperation, it is possible for the developers to work directly with the AO. Sarker et al. (2012) introduce yet another addition to external stakeholders by making a distinction between the global ERP provider and their local partners actually delivering the system to the AO. The consultancy entity is further divided into customization and organizational implementation functions whereby the former communicates with the vendor and the latter with the AO, more precisely local designers (Dittrich et al., 2009). Local designers communicate within the customer organization and its actual end-users (see also Sathish et al., 2004).

There are also different stakeholders within the AO (Davenport, 1998). Different functions and roles can be identified (c.f. Millerand & Baker, 2010). For example, it is common to have an executive steering team or a steering committee that is responsible for the overall ERP project and report directly to the top management. A project champion could also be named. In most cases, a specific project team is appointed; its members are usually selected from different functions. (Sathish et al., 2004). In ERP projects, different business units and the IT department have a central role. The business unit can be further divided into managers and end-users as well as the IT department into managers and technical staff members, such as the designers (Dittrich et al., 2009; Sathish et al., 2004). Also, end-users have a much bigger role in ERP projects than in traditional systems development (Soh et al., 2000).

Since the scope of the ERP system extends over the AO's boundaries, it is evident that both business customers and suppliers are stakeholders in the EDN (Davenport, 1998; Koch, 2007). If the ERP development considers, for example, an extranet function, the AO's customers and suppliers can have a direct connection to the system, making them both possible stakeholders. Also, different authorities or government agencies can be stakeholders (Sathish et al., 2004) as legislation, for example, sets certain rules for accounting (Pouloudi & Whitley, 1997; Liang & Xue, 2004). Figure 1 presents an overview of the stakeholders in EDN.

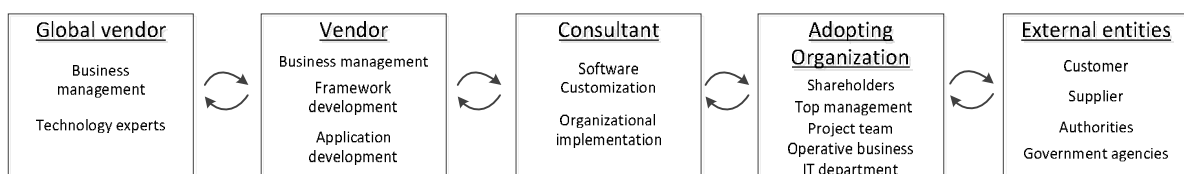


Figure 1: The stakeholders in ERP development network (inspired by Dittrich et al., 2009)

Thus, EDNs consist of a multitude of actors. The stakeholders have their own expertise in very different fields, which makes common understanding about the scope of the system and the

establishment of a mutual “language” crucial (Baskerville et al., 2000; Jones, 2005; Soh et al., 2000). The development usually requires a significant amount of domain knowledge to be transferred within the EDN over the organizational boundaries. This is, however, not an easily accomplished task since the individuals and organizations have different objectives and goals (Alanne et al., 2014; Volkoff et al., 2004; Liang & Xue, 2004). This emphasizes the need to cross the boundaries between different groups to manage and improve coordination and knowledge sharing between the participants (Carlile, 2004; Levina & Vaast, 2005).

This activity is often assigned to boundary spanners that facilitate knowledge sharing between various groups (Adams, 1976; Pawlowski & Robey, 2004). Boundary spanners have the potential to gain significant power and influence others. Their different roles range from innovator and champion (project leader and sponsor) to gatekeeper and implementer (Esteves & Pastor, 2002; Heikkilä et al., 2008). According to Heikkilä et al. (2008), the existence of each and every role is connected to the success of the network. The literature on boundary spanning has identified at least five different roles that the individual may simultaneously play, namely gatekeeper, scout, ambassador, sentry, and guard (Ancona & Caldwell, 1992). It is thus reasonable to formally appoint boundary spanners, although multiple roles should not overlap on a personal level (Friedman & Podolny, 1992). Yet there are differences between formal intentions and appointments and their practical concretization. Levina and Vaast (2005) argue that nominating a certain individual as a boundary spanner does not guarantee success. On the contrary, the impact of a *boundary spanners-in-practice*, engaging in negotiations between the groups, may be more significant. Boundary spanning is a complex concept where one’s role might simultaneously both assist and hinder the cooperation.

### 3 RESEARCH METHODS AND SETTING

In order to understand ERP development networks and their operations, an interpretive case study approach (Walsham, 1995) with two case EDNs was chosen, simply because we had access to those. Data collection focused on identifying the characteristics and issues related specifically to EDN in general rather than idiosyncratic to a certain organization. The interviews were conducted in January-June 2013, and analyzed in August-December 2013.

#### 3.1 Data collection

Data collection in each case EDN began with an initial interview with the main contact person (e.g., CIO of the AO). Subsequent interviewees were chosen with snowball sampling, i.e., the interviewee recommends a suitable person to be interviewed. Snowball sampling continued until no new names were brought up. A critical mass of data was thus obtained (Myers & Newman, 2007). We also studied the organization charts to ensure that all relevant stakeholder perspectives from the organizations were considered. Table 1 summarizes the sample of the study.

Interviewees	AO Business	AO IT	ERP vendor	Offshore	Third parties	Total
Case A: Centralized model	2	6	6	1	2 (Middleware vendor)	17
Case B: Distributed model	6	5	4	-	1 (Corporate IT)	16
Total	8	11	10	1	3	33

Table 1. The interviewees and their organization positions

The interviews followed a semi-structured theme-interview protocol. The protocol was constructed on the basis of an earlier literature review. The themes were: identification of stakeholders in the latest ERP development activity, own experiences, and successful/problematic issues. Each interview was conducted onsite at the case organizations. They lasted from 11 to 98 minutes, the average being

about 60 minutes. The interviews were recorded and transcribed. In addition, the researchers wrote field notes during the interviews to reflect their own impressions. The researchers also collected secondary research material such as management documents and memos to better understand the contexts.

### 3.2 Data analysis

Dedicated researchers were responsible for the data analysis of each case EDN. First, immediately after the first interview, the responsible researchers coded their own data in order to 1) identify the EDN and its actors, 2) describe how this network operates, and 3) identify what is difficult. Then, both EDNs were described and illustrated by the responsible researcher. Due to the initial individual coding, the levels of codes needed to be harmonized to allow their comparison. Several brainstorming sessions were conducted to discuss and iterate the findings and to draw the implications. Table 2 shows examples of codes and their harmonization.

Extracts from the data	Used codes	Interpretation and harmonization
Case A: <i>“It has been challenging to transfer that knowledge to outsiders with only technical IT understanding, and no understanding of the business.”</i>	“Challenge: knowledge transfer,” “Challenge: homogenous group”	The domain knowledge of each stakeholder group is difficult to transfer outside of the group, and further throughout the EDN
Case B: <i>“The understanding in India is not always as deep as here regarding to [domain knowledge].”</i>	“Business knowledge,” “network”	
Case A: <i>“We are training new developers and making sure that deliveries work there but if a key person decides to leave then it’s gonna have a big impact.”</i>	“Challenge: People changing”	Key individuals play a significant role in the project, their absence disrupts the whole project.
Case B: <i>“...there was a clear dip in performance when [project manager] left, there was no single person who has the 13 years of experience about the system.”</i>	“Key person leaves,” “communication channel”	

Table 2: Examples of coding and harmonization

Further analysis focused on the issues arising from the data: communication channels, transfer of domain knowledge, and the role of key individuals.

## 4 THE NETWORKS AND DEVELOPMENT MODELS

Two different EDNs with varying development models are identified. Both cases are presented first separately and then in comparison to each other.

### 4.1 Case A: Centralized Development Model

*“The customer [AO] has a certain organizational structure with their own IT organization. Their business units are customers to their IT department. Our customer is their IT organization. This is the old model that we’ve stuck with.”—Vendor*

In case A, the AO is a large, global manufacturing organization with about 30,000 employees and an annual revenue of about 10 billion euros. The development of their customized ERP system for sales and logistics had already started in the mid-1990s when their logistical business processes were poorly supported by commercial ERP modules. The system specification started in the mid-1990s, and by the time of its first rollout, it had already exceeded both the budget and schedule because of many crises and unexpected events during the implementation. For example, the AO had merged with another company, resulting in competing systems and uncertainties.

The AO drove the development from the very beginning. The vendor stepped into the project after the definitions had already been finalized. Nevertheless, the vendor had a key role in the development. As the years went by, the vendor accumulated business knowledge on the AO's business by building numerous other (sub-)systems and eased the system integration. Finally, the system came into use in its intended scope in all the facilities world-wide. Also, some parts of the development have been offshored to cut the AO's costs down. Nowadays, new features are initiated completely by the AO's business areas. The vendor would like to be more involved in decision making related to those features and their implementation.

The ERP system, started in the 1990s, is still constantly under developed. The AO considers that this kind of system is "never complete":

*"Minor development has to be done constantly. Then there are separate bigger projects under which bigger changes are made. A couple of those are done every year."*—AO IT Management

The EDN consists of the AO, the vendor, their joint groups, and external parties. In each organization, there are several groups of stakeholders: the AO consists of the user board, several business areas, the steering group, and the IT department; the vendor is divided into development, operations, and offshored parts; and external stakeholders include consultants, supply chain partners, standardization organizations, and subcontracting vendors of supporting software and tools. The overall view, with the most relevant connections, is displayed in Figure 2.

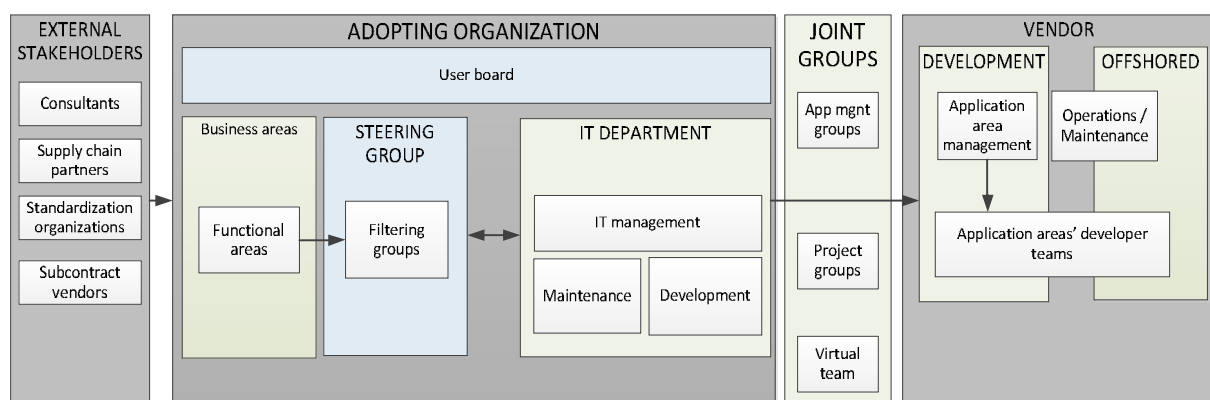


Figure 2. Case A: ERP development network and formal communication channels

The needs for new ERP features or functionalities emerge from the three business areas (BA). These ideas are handled by a group of business representatives that form so-called filtering groups, each covering a certain functional area of the system. The filtering group then reviews and pre-prioritizes the requests, and negotiates with the BAs. The steering board, consisting only of business representatives, supervises the filtering groups. Its purpose is to facilitate information sharing between the BAs. The user board, formed by both top management and BA representatives, oversees and is responsible for the whole development and ERP evolution. After obtaining acceptance, the filtering group presents the new development initiative to the IT department.

*"We can roughly say that it [the decision making on new features to be developed] is as very much business-oriented"*—AO IT Development

The IT department then addresses the initiative by explaining the business side concerning what these decisions mean in practice, and whether they are feasible. For example, the architectural evaluation is made to see if there are duplicate features. The IT department, divided into management and development units, also prioritizes the requirements. The development group is further divided according to system functional areas.

After the AO has decided on the development initiative, a list of development requests is passed to the vendor. The vendor makes the technical evaluation of the initiative, and communicates the results back to the AO. This estimation might lead to actual development or even abandonment of the idea, for example, if a request would take too much time.

The vendor side is divided into operations and development functions. The operations function keeps the system up and running and is responsible for its infrastructure. The development function is divided into application areas, covering a certain functional area of the system. Each application area has a team leader in the home country while the main coordinator and all the developers are outsourced in Asia.

The development is coordinated by inter-organizational joint groups. The AO and the vendor have formed an Application Management Group that contains key persons from both sides. It monitors the development and meets once a month. The Application Management Steering Group enters the situation in cases of higher level decisions or conflicts. This group only meets once or twice a year, and, according to the vendor, “is not needed very often nowadays.” A project group is formed for every development project. It has the application area leader, developers, and corresponding customer IT representative. The project steering group contains managers from the vendor side (service owners) and (mainly) AO business representatives. Project groups are established for each initiative that is not considered as “minor development.” Project groups are mainly led by the AO:

*“They [AO] have their IT-persons who take care of the definitions. And the project manager is often from the AO side. We also have our own project manager, but these projects are mainly driven by the AO”*—Vendor Development

In addition to project groups, unofficial virtual teams with the AO are also organized. However, recently it has been difficult to commit the AO to these meetings.

There are also external partners in the EDN. In order to improve supply chain collaboration, standardization efforts with different organizations have been considered. Due to the complex supply chain, integration with the partners’ systems is often necessary. Supporting software vendors consist of database, middleware, operating system, servers, and development tools vendors. Yet the external consultants only have a minor impact on development. They just assist in major technical upgrades or benchmarking the system of other ERP products.

#### **4.2 Case B: Distributed Development Model**

*“...it’s inevitable [to have many interfaces], there are the technical issues, then there is the functional issues of separate modules, these all involve different people...it’s the same at the vendor’s end, for back office there’s one person responsible, and for functional module A there’s another...doing this through one single link point is unnecessary because it would become only bureaucracy.”*—AO Corporate IT

In case B, the AO is a global service provider in the retail business. The AO has over 1,000 sales outlets, which mostly operate on the franchising or partnership principle. The AO and the vendor, their headquarters in the same country, have cooperated over 15 years as the vendor has also provided previous ERP solutions. The current renewal project was started because the old system did not support critical business processes anymore, and the vendor needed to upgrade the software platform. Even though the project was initialized in 2008 with tender rounds and selections, the actual development began in 2010 with planning and definition. Three development phases can be identified: planning and systems specification (by the vendor), development and piloting, and rollout/going live. In each phase, the stakeholders and methods varied. However, in general the development resembles package software development as the system will also be used later by other customers. Thus, there are some generic parts while some remain exclusively to the AO. This requires certain compromises. Still, at this point, the AO is the only customer implementing the system.

At the time of writing, the ERP project is in the piloting phase with first rollouts made. When fully implemented, the system will cover over 90 percent of the AO’s business operations from sales and inventory management to customer relationship management. However, currently only some of the sales outlet modules are in focus; the back office system is yet to be planned.

The main entities involved in the development are the AO, the vendor, the offshoring partner, and external stakeholders. The AO is divided into strategic management, support functions, operative



business areas, and the IT department. The vendor has three groups: customer liaison, development (further split into onshore and offshore), and business management. External stakeholders include corporate level IT, supplier, government organs, the vendor's other customers, and subcontractors. In addition, there are two steering boards overseeing the development activities: one for the entire ERP project from the AO's perspective and another for the product from the vendor's perspective. The EDN, with the most relevant connections, is displayed in Figure 3.

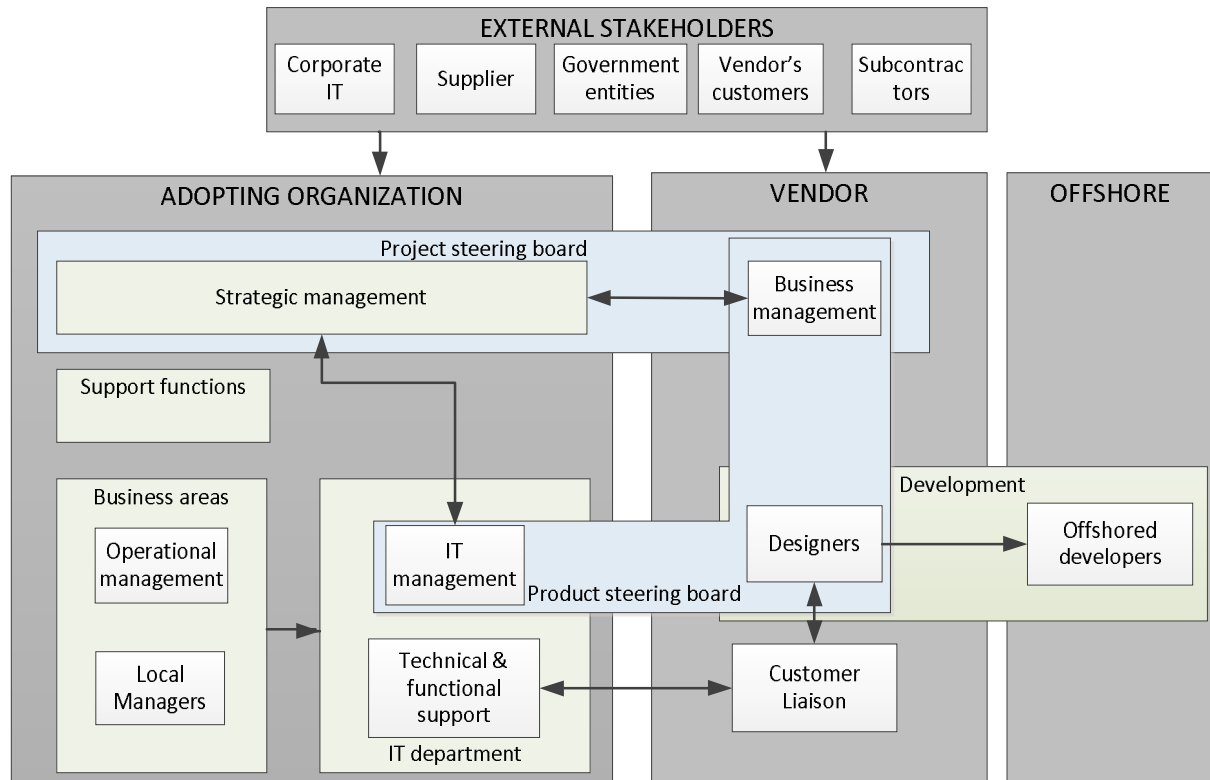


Figure 3. Case B: ERP development network and formal communication channels

There are two distinctive types of development activities: correcting operational level errors and making minor modifications, and creating new features for business functions (i.e., answering to changing business needs). For the operational level, the development model is straight-forward, at least officially. The change requests originate from the business areas, both from the local level and management level. Occasionally, the different support functions provide their inputs to the development, for example, in the form of guidelines related to accounting. In the ideal situation, the IT department collects all system related information, for example, operational errors and corrections, from and within the AO.

*“...there are two persons who gather or receive errors and development ideas about the new [system] and record these, and communicate them towards the vendor.”—AO IT Support*

This is supported by the AO's business manager:

*“The information [concerning the development] comes from the IT department since it is actually the only link where we pass the information and from which the feedback comes the other way around.”*

IT support gathers these details and evaluates their seriousness. This centralization enables the IT department to monitor the information flow, remove duplicates, and detect possible conflicting needs. Different documents can also be updated and matched with these needs. The IT management is in touch with the strategic management to keep them informed about the development and also to receive strategy level guidelines and instructions. After the development initiatives are confirmed and approved at the IT department, they are passed to the vendor.

Once the vendor receives the initiative, officially the account manager (customer liaison) handles it by evaluating whether it could be solved immediately without involving the development team, or whether it is even in the scope of the system. If the initiative requires major development, the customer liaison passes it onwards either to the product management, or straight to the designers. After matching the initiative, the lead designer starts working on it, designing the changes and/or new features and writing an internal documentation to be forwarded to the offshored developer team.

*“Part of my communication goes to India, where we also have developers. I employ them, give them specifications about what to do and make sure that what they do is what the customer wants.”*—Lead Designer

The offshored developers eventually do the coding and send their output back to the vendor. As a part of the development team, the vendor has dedicated testing persons who perform the technical approval of the code.

New business needs and new features are created through an ambiguous process. Officially, business needs are gathered regularly in the joint workshops. All business area managers participate in the workshops, led by the IT manager. The results are compiled into memos. These memos transfer detailed information about business to the IT department, which will use it in further cooperation with the vendor. More precisely, this transfers the information about business rules and needs to the vendor to acknowledge. At the vendor side, this is combined with their system knowledge and further specified into documentation and placed into a backlog.

*“...last year we had a backlog for each module where we had the wishes, the bigger things, but when there are lots of small details and (other stuff), we have a case management application in our own intranet, made by ourselves, which is also visible to customers.”*—Vendor Business

The project steering committee consists of the corporate CIO, top management of the AO, and vendor CEO. This committee is essential in overseeing the whole project and ensuring it is moving in the right direction. The product steering committee, on the other hand, is the vendor's internal group, including the product development leader, the technical chief, the CEO, and the lead designer. However, the AO has been granted a permit to join its meetings as an observer. Their main purpose is to maintain the balance in creating the product, i.e., to make sure decisions about the AO's unique requirements are aligned with the development of the general product – to be later sold to other customers.

External partners in the EDN have more of a restricting role, rather than actually engaging in negotiations regarding the system. For example, the AO's suppliers and government entities are connected on the system level, which requires certain technical solutions or some modifications done to the system under development. The AO and their corporate IT have a similar role since all the technical infrastructure related decisions and hardware choices are done on the corporate level. The vendor also uses subcontractors for some parts of the system development, for example, for designing the user interface.

## **5 DISCUSSION AND IMPLICATIONS: COMPARING THE NETWORKS**

We have identified two very different EDNs: one with centralized and the other with distributed decision making concerning the development. In the centralized model, the course of the development ideas to production is rather straight-forward “always” following agreed channels. In the distributed model, the course is ambiguous as the development needs are transferred on various levels and routes.

Both EDNs allow us to assess who has the most power to influence the overall development. In the distributed model, case B, the official decision making power seems to be at the AO strategic management who sets the directions for the development. This suggests that the AO has quite substantial leverage on the overall development. This may, however, also be unfavorable for the

vendor because when trying to develop a product, the customers are usually better kept at a distance (Koch, 2007). Still, as the vendor business management is a part of both the project and product steering groups, it ultimately has the best knowledge about the ERP as a whole, and the possibility to steer major decisions. In case A, the situation is rather simple. The AO business side practically dictates the direction of the development, and makes the ultimate decisions. The conflicts are resolved by the user board, albeit the business area representatives make all decisions concerning development and functionality. Despite evident differences in the control mechanisms, in both EDNs the AOs assume they have the overall control in development:

*“The vendor does what we tell them to do”*—Case A, AO IT Management

*“We have a pressuring means towards that end [vendor], so that all the other doings will stop if we have that kind of [major] problem.”*—Case B, AO Strategic Management

Despite the literature emphasizing the use of external consultants, they were not part of EDN in either case (e.g., Sammon & Adam, 2002), even though the vendors adapted some of those characteristics. For example, in the distributed model, the vendor’s organizational structure consists of a separate customer and development side. This follows Dittrich et al.’s (2009) suggestion to the consultant organizations. Additionally, external parties, other than the AO or the vendor, may have a significant impact on ERP networks (Koch, 2007). However, this was not the case here. External parties, such as customers or suppliers, had a rather minor role in contributing to system development in our EDNs. Nevertheless, these stakeholders cannot be dismissed entirely as they set certain limitations such as technical restrictions from a database vendor. Although external parties had no vital roles in either EDN, this research strengthens the need to consider relationships other than just a single organization or the “dual-arena” of the AO and the vendor (Koch, 2007).

After critically analyzing the EDNs and the development models, three challenges emerged from the data. They were related to communication channels, transferring domain knowledge, and the role of key individuals. These are all intertwined, but they are discussed separately next in order to improve clarity.

## **5.1 Communication channels**

A simple, yet significant, issue in development models is the communication channels between AO and vendor. In the centralized model, communication is mainly performed via joint groups, and on an irregular basis, while in the distributed one it is done continuously at multiple levels; separate groups need not be set. In the distributed model, the relationship between the AO and the vendor is closer to partnership and entails more direct cooperation. However, with this the complexity increases; boundaries between stakeholders are crossed from various points and official communication channels are bypassed.

*“Everyone has their own contacts.”*—Case B, AO IT Management

The use of informal channels has a significant effect on development activities in the EDNs. For example, an alternative way for development requests that arrive to the vendor is that certain business representatives contact vendor personnel directly by sending a “wish list” via email. The vendor’s designer discussed these informal requests as follows:

*“...I always try to keep clients happy. When there’s a wish from AO...I’m happy to add the little feature there to keep them happy even if it’s not part of our processes and it slows down the rest of the development. You have to balance quite a bit with that.”*

This obviously hinders the manageability of the whole EDN. Nevertheless, informality enables flexibility in the development, usually considered important for IS development projects (Dittrich et al., 2009). This is still an approved method in the distributed model as the strategic management of the AO sees the overall development activities as constituting a holistic, multi-actor network.

The centralized development model does not entail the risk of informal channels. Communication is very rigid and controllable. However, it weakens the possibility for other parties to fully participate.

Without taking the joint groups into consideration in case A, the only place where two-way communication can be established between the groups is the connection between the IT department and filtering groups. Yet here the IT department acts more as an advisor than a legitimate negotiator. Either way, Sarker et al. (2012) have highlighted that the profound involvement of the vendor and other stakeholders helps in reducing mismatches in the processes.

## 5.2 Transferring domain knowledge

Domain knowledge is business knowledge about the AO's processes or technical knowledge, such as programming and testing, which translates business needs to software solutions (Al-Salti & Hackney, 2011). In both cases, the AO has a strong belief in the vendor's knowledge, competence, and understanding about the AO's business. However, this is not reflected onto the development models. For example, the role of the IT department is argued to often be relatively large, making it problematic to include business knowledge into the system (Al-Mashari et al., 2003). This is not the case in the centralized model. But this brought out another problem. Unidirectional communication leads to a situation where the IT potential is not fully utilized as technological know-how from the IT department cannot be transferred to business personnel. The problem has also been acknowledged by the vendor. The vendor is responsible for developing the technical roadmap, while the AO makes the business roadmap. This has turned out to be problematic, so the vendor would like to have more direct contact with the AO's business. The vendor has difficulties in "selling" new features, for example, mobile clients, for the AO. Without a clear business case and cooperation with the AO's business, developing these ideas further has turned out to be difficult.

*"We would like to be closer with the [AO's] business area so that they could directly talk with the businesses... We have to convince them that we add the value there."*—Case A, Vendor

The overall impact of the system on the AO's business is significant in the distributed model yet the development is currently IT centric. The IT department is responsible for ensuring that development is aligned with business. This assumes their business process knowledge is strong. A business manager states that the IT department claims they understand the business. In reality, however, they do not understand it as well as they should. This hinders the possibility to gain advantage for the business:

*"...so far, the system has been maybe a little more of a disadvantageous than advantageous. That is, from the perspective of developing the business operations."*—Case B, AO Business

Understanding the importance of IT and more importantly the possibilities of IT to redesign business processes is required (c.f. Al-Mashari & Zairi, 2000; Davenport & Short, 1990). This requires transferring knowledge about the system and its possibilities and limitations to the other direction, i.e., toward business.

Regarding the development requests, both EDNs have multiple nodes. The AO's business process knowledge must be, at least on some level, forwarded all the way to, for example, offshored units or to subcontractors. This is difficult for several reasons:

*"There's a lot of know-how in the heads of our guys in this country. It has been challenging to transfer that knowledge to outsiders with only technical IT understanding, and no understanding of the business at all. In Asia, it's hard to find developers that would understand our domain."*—Case A, Vendor

*"On the one hand, they are [foreigners] and on the other hand they aren't our own employees and not so interested in the knowledge."*—Case B, Vendor Business Management

Especially in case B, the distributed model, the vendor's designers are the only link to the offshored team. Lots of trust is laid on them. This emphasizes that appropriate methods to avoid misunderstandings should be carefully selected. Also, organizing the work in such a fashion holds the risk of distancing the vendor's onshore designers from the actual technology.

### 5.3 Role of key individuals

Our findings show that the EDNs can be constructed in various ways. They not only cross organizational boundaries, but also split the organizations into smaller, distinctive groups. These groups can be seen as kinds of communities of practice (CoP) in which members share common language and practices (Brown & Duguid, 1991). These include, for example, a business site, the AO's IT department, the customer side of the vendor, and an offshore development team. This further stresses that the ERP development should not be considered as only between the AO and the vendor, but between several distinct communities – i.e., the EDN is a “*community-of-communities*” (Brown & Duguid, 1991, p. 53). Achieving a common understanding between these CoPs is much more difficult than within them (Carlile, 2002; Volkoff et al., 2004). The boundary spanners role is thus highlighted in EDN as they are capable of facilitating the communication across CoPs (Levina & Vaast, 2005; Volkoff et al., 2004).

Pawlowski and Robey (2004) stated that IT professionals can act as knowledge brokers, transferring business and IT knowledge across units within the organization because of their department's strategic position. Similarly, in the centralized model, the IT department has the ability to span organizational boundaries. There are functional teams within the IT department cutting across several business areas. In the distributed model, the IT department does not only cross the AO's internal units, but also delivers business knowledge to the vendor, thus expanding the former definition. The presence of all boundary spanning roles is considered necessary for the project's success (c.f. Heikkilä et al., 2008; Volkoff et al., 1999). However, in the centralized development model, no clear boundary spanning roles can be identified. The absence of such is not considered harmful since the overall model is rather explicit and the ways of working have been stabilized. This indicates that boundary spanning roles are more important in emerging situations and EDNs than in stable modes of cooperation.

Yet the importance of boundary spanners is evident in both EDNs. The meaning of different types of spanners (Levina & Vaast, 2005) is especially noticeable in the distributed model, where the model alone necessitates this. At the beginning of the project, a project manager was appointed to work between the stakeholders in the EDN, to be a boundary spanner. The project manager was indeed a spanner-in-practice, for example, named as vital for the project knowledge by almost every interviewee. When he left the project, no one was appointed to replace his role. Yet few individuals became spanners-in-practice. Currently, there are many nominated boundary spanners assigned to represent their group's interest, for instance operational business management, and the vendor's customer liaison. Still, from the development point of view, these stakeholders have less impact than the initial spanners-in-practice. Currently, local managers bring in the business knowledge and introduce ideas to the IT department. On the vendor side, lead designers perform tasks not in their job description, for example, customer liaison's tasks, by informally contacting the AO and then negotiating with others in their side. On the contrary, in the centralized model, the IT department does not really achieve a similar kind of intensive method of working because “*spanners-in-practice must have legitimacy, not only as participants, but also as negotiators on behalf of the field whose interest they are to present*” (Levina & Vaast, 2005, p. 353).

## 6 CONCLUSIONS

In our study, the EDNs are described in more detail than in the literature. Dividing the EDN in such a fashion allows in-depth analysis of the relationships between the groups instead of just focusing on the holistic overall picture, for example, varying roles of stakeholders and knowledge transfer between individuals or groups. Even though the current projects are at different phases, both development models are results of a long-term relationship. This makes the development models comparable. Both models are serving the AO business needs simultaneously taking into consideration the concerns of all relevant stakeholders. The centralized development model is considered successful mainly because of the straight-forward communication and clear decision making. The distributed development model, on the other hand, is considered flexible and sensitive to multidirectional

knowledge exchange. Still, the ERP development in networks entails certain challenges related to communication channels, transfer of domain knowledge, and the role of key individuals despite the development model.

Our study has its limitations. We have only studied two EDNs both coming from a similar cultural environment that is generally considered very democratic; emphasis is put on mutual trust instead of formal contracts or other legal agreements, within and between organizations. Thus, the findings may not be directly applicable to, for example, North American organizations. Additionally, the AOs' IT departments are rather different, i.e., case A has a large group that has plenty of expertise of its own, while in case B it is very compact and usually only responsible for support activities. These issues may affect the generalizability of our findings when considering different IT governance models. Also, we have investigated for most parts tailored ERP systems, which may differ from the EDNs implementing and developing standardized packages.

The study has opened up new areas for research. As the aim of this paper was to provide a general view for the EDN and explain how it functions, more research is needed on its different details. For example, in order to evaluate individual actors or stakeholders, the stakeholder theory might provide new insights (Freeman, 1984). It could be used to study which stakeholders are most relevant, and how they should be managed in order to achieve the best results from the overall project's perspective (Mitchell et al., 1997). Another direction is looking at these networks as organizations and assessing them in light of, for example, structuration theory (Orlikowski, 1992).

The network pictures (Figures 2 and 3 earlier) describe the stakeholders who are involved in the EDN. These descriptions represent only the current situations. Yet, as both projects are long and consist of several phases, the stakeholders and their roles have also evolved over the years. For example, in case B, the project manager resigned in January 2013. This forced some changes in the EDN. Although the absence of experience and knowledge is considered harmful for the project management, the resignation was also argued to have positive impacts for the overall cooperation in the EDN, for example, the introduction of a more rigorous documentation policy, as the formal boundary spanner role disappeared. From a more practical perspective, it is thus interesting to examine how the EDNs evolve, i.e., what stakeholders have been present at any moment of time. Also, since communication and cooperation are central issues in the EDNs, tools and systems used to achieve these would be worthwhile to investigate.

The study thus makes contributions to research: first, the networks and their descriptions illustrate that there are actually several different organizations and actors cooperating in ERP development. Second, despite their decision making being governed differently, they both face similar kinds of challenges in practice, namely communication channels, transferring domain knowledge, and the role of key individuals. For practitioners, the study demonstrates two different, yet working solutions to manage a complex EDN where stakeholders have different goals. The case narratives themselves can be seen as a contribution to practice, serving as a consultable record (Walsham, 1995).

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